either late Pliocene or early Pleistocene. It has been shown to be separated from the Santa Fe formation, of Miocene age, by an important erosion interval. It can be shown to be preglacial on stratigraphic grounds. Alluvial fans and slopes are widely developed about the sides of the valley. The great Rio Grande fan occupies a fourth or more of the whole valley bottom. The water-bearing sands conform to the contour of the fan, showing that it was developed contemporaneously with the deposition of the formation. Likewise on the east side of the valley the alluvial fans and slope of the Sangre de Cristo range blend and are contemporaneous with the sands and clays of the Alamosa formation. The Pleistocene valley glaciers of the west side of the range just reached down to the alluvial slope and their concentric terminal moraines surmount the crests of the alluvial cones, spreading out from the valleys as the author has previously noted.[2] The sediments of the fans and of the Alamosa formation are therefore preglacial. The valley glaciers of the Rocky Mountains of both the earlier and later periods of glaciation are regarded as rather late Pleistocene. The best age determination that can be made from a stratigraphic standpoint, therefore, is that the Alamosa formation is either late Pliocene or early Pleistocene. Four species of fresh water shells collected at Hansen's Bluff, in the uppermost strata of the formation, are identified by Dall as a Quaternary assemblage.

C. E. Siebenthal

THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

The first annual meeting of the society was held in affiliation with the American Association for the Advancement of Science in the Harvard Medical School, Boston, Mass., December 30 and 31, 1909. The sessions were presided over by Dr. L. R. Jones. The society starts with 130 charter members. Fifty members were in attendance and the meeting was regarded as a great success. The rooms and other facilities provided by the local committee were very satisfactory.

[2] *Jour. Geol.*, Vol. XV., 1907, p. 15.

The following officers were elected for 1910:

President—Dr. F. L. Stevens, North Carolina College of Agriculture and Mechanic Arts.

Vice-president—Professor A. F. Woods, College of Agriculture, University of Minnesota.

Secretary-Treasurer—Dr. C. L. Shear, U. S. Department of Agriculture.

Councilors—Dr. L. R. Jones, University of Wisconsin; Professor A. D. Selby, Ohio Agricultural Experiment Station; and Professor H. H. Whetzel, Cornell University.

It is expected that the next annual meeting of the society will be held in conjunction with the American Association for the Advancement of Science at Minneapolis, Minn.

The society empowered the council to undertake the publication of a phytopathological journal if the necessary financial and editorial arrangements could be made.

The membership fee for the year 1910 was fixed at one dollar, with the provision that in case a journal was established during the year an assessment of one dollar more should be levied upon each member to cover subscription to the journal for the remainder of the year.

A letter from the Society for the Promotion of Agricultural Science, requesting the Phytopathological Society to appoint a committee for the purpose of considering the question of affiliation of the two societies was read. The society accepted the request and instructed the president to appoint a committee of three for the purpose. Dr. Chas. E. Bessey, Mr. F. C. Stewart and Dr. John L. Sheldon were designated later.

Upon motion the society voted to direct the president to appoint two delegates as representatives to the International Botanical Congress, which is to be held in Brussels in May. Dr. W. G. Farlow and Dr. C. L. Shear were appointed.

The society also adopted a motion providing for the appointment by the president of a committee of five to draw up rules and make recommendations concerning the common names of plant diseases. The president appointed Dr. F. L. Stevens, Dr. H. von Schrenk, Dr. E. M. Freeman, Mr. W. A. Orton and Dr. G. P. Clinton.

Owing to the recent introduction of two serious plant diseases, the yellow wart disease of the potato, caused by *Chrysophlyctis endobiotica*, and the white pine disease, caused by *Cronartium ribicolum*, into America, the society unanimously adopted a motion directing the president to appoint a committee of five to draft appropriate resolutions regarding these diseases and take

steps to secure such action as would prevent their further introduction and spread. Dr. H. Metcalf, Dr. H. T. Güssow, Professor H. L. Bolley, Professor A. D. Selby and Mr. W. A. Orton were appointed.

A joint session with Section G of the American Association for the Advancement of Science for the reading of papers was held Thursday afternoon, December 30, and two separate sessions were held Friday, December 31. Abstracts of the papers read follow:

Morphology and Life History of Puccinia malvacearum Mont.: Mr. J. J. TAUBENHAUS, Delaware Agricultural Experiment Station.

Morphology.—The mycelium of this fungus is septate, branched and intercellular. It is very rich in oil globules and protoplasm which gives it a red orange color. Haustoria are rarely found. A characteristic mycelial cushion is formed under the epidermis of the host. This cushion is made up of large mycelial threads irregularly interwoven and at the tips of which knobs are formed. Each knob bears from two to five teleutospores, each teleutospore starting as a little bud. The teleutospores are found to greatly vary, in both form and shape. One-celled and three-celled are fairly common, while four-celled teleutospores are found more rarely. The sporidia are formed in two ways: First, the promycelium divides into four pear-shaped bodies which bear the sporidia. Second, the promycelium breaks up into four cells which separate and each cell forms and bears a sporidium.

Life History.—The fungus is carried over winter as developing mycelium, as hibernating teleutospores and with the seeds. Late in the fall young sprouts are formed at the base of the hollyhock. These soon become infected. The plants are covered up with a mulch to protect them from the cold. The young sprouts grow considerably under the mulch. During late fall the leaves do not show evidence of infection. This becomes evident during the winter when the young sori appear as white dots which become more yellow and finally bear mature teleutospores early in the spring. Infected hollyhock leaves were gathered, part of which were kept out of doors and part in the culture room. Germination tests were made every month from that material. The teleutospores germinated and produced an abundance of sporidia in the middle of the winter as well as early in the spring, proving that the fungus may be carried over as hibernating teleutospores.

In the fall of 1908 badly diseased seeds of *Malva rotundifolia* were collected and kept over winter in the laboratory. Early in the spring these seeds were planted in flats in the greenhouse, where no outside infection could take place. Ten days after germination half of the seedlings showed well-developed sori on the cotyledons or on the hypocotyl. By artificial inoculation *Puccinia malavacearum* on the hollyhock is readily communicated to the *Malva rotundifolia* or *vice versa.*

Common Names for Plant Diseases: Dr. F. L. STEVENS, North Carolina Agricultural and Mechanical College.

The methods of common naming of plant diseases in America, Germany and France are discussed and the necessity of uniform usage among American plant pathologists is urged, and the appointment of a committee to draft rules for the nomenclature of plant diseases is recommended.

Malnutrition Diseases of Cabbage, Spinach and other Vegetables: Mr. L. L. HARTER, Bureau of Plant Industry. (Read by Mr. W. A. Orton.)

This disease was first observed by Mr. W. A. Orton in several of the trucking sections along the Atlantic coast, where it affects nearly all vegetables where intensive cultivation is practised. Every attempt to isolate an organism that might be responsible for the trouble resulted in failure.

The disease is characterized as follows: The plants grow poorly, have small, stubby roots with few or no laterals. The chlorophyll disappears from between the veins and around the margin of the leaf, while along the midrib and veins the color remains normal. The leaves are very much thickened and brittle. By quantitative analysis, diseased material was found to contain 77 per cent. more starch than the normal, which can be accounted for by the fact that the translocation diastase has probably been so weakened as to be unable to act upon starch.

The disease occurs only in soils containing a large amount of acids, which doubtless interfere with the normal activities of the plants and the growth of microorganisms.

The application of calcium carbonate in the soil results in the development of normal plants.

Contributions to the Life History and Structure of certain Smuts: Dr. B. F. LUTMAN, University of Vermont.

This work was suggested by the recent discoveries in the sexuality of the rusts and is an

attempt to discover whether similar phenomena occur in the smuts. It also aimed to find the relationship of the group from their finer structure.

It has been found that the mature teleutospore of all smuts is uninucleated, but that there are two nuclei in the younger one in the Tilletiaceæ and possibly so in the Ustilaginaceæ. The mycelium of the former group shows many binucleated cells, like the rusts, but in the latter group it is multinucleated. This would seem to indicate that the smuts of the *Tilletia* group are more nearly related to the rusts than those of the *Ustilago* group.

The complete life history of the oat smut (*U. levis*) was traced. It was found that the promycelial cells were uninucleated, the conidia uninucleated, but that they became multinucleated immediately after putting out a germ-tube. Infection occurred in three to five days and the entire tip of the seedling was full of the intercellular mycelium. The entire mycelium breaks up into spores at the time when the rudiments of the flowers appear.

Life History of Melanops quercuum (Schw.) Rehm forma vitis Sacc.: Dr. C. L. Shear, Bureau of Plant Industry.

The fungus under consideration has had a great variety of names applied to it in its different stages. The ascogenous stage is best known in Europe under the name *Botryosphæria Berengeriana* de Not. In America it has been frequently called *Botryosphæria fuliginosa* (M. & N.) E. & E.

Various surmises have been made as to the pycnidial form of this fungus, but all have heretofore been based upon the close association of perithecia and pycnidia on the same specimen.

Pure cultures made from carefully isolated single ascospores have produced pycnidia which at first discharged hyaline, non-septate spores of the *Macrophoma* or *Dothiorella* type. Later the spores borne in the pycnidia became brown and many of them uniseptate, corresponding exactly with *Sphæropsis viticola* Pass and *S. Peckiana* Thüm, which were also found associated with the perithecia on the specimen from which the cultures were made. They also agree in all morphological characters with *Sphæropsis malorum* Peck and *Diplodia pseudo-diplodia* Fckl. The ascogenous stage is frequently found on the apple and a great variety of other trees and shrubs and has generally been regarded by mycologists as one and the same species, though Saccardo treats some of the specimens on different hosts as forms. In a few cases another form of pycnospore was found in the same pycnidium with the *Sphæropsis* spores, the sporophores being intermingled and clearly arising side by side from the wall of the pycnidium. These spores were small, hyaline, cylindrical and $2–3 \times 1\ \mu$. These were found on the hosts and not in the cultures. The fungus is not known at present to cause any serious injury to the grape, but the form on the apple causes the well-known "black rot," leaf spot and canker.

The Chestnut Bark Disease: Dr. Haven Metcalf and Professor J. Franklin Collins, Bureau of Plant Industry.

The active parasitism of *Diaporthe parasitica* Murrill has been verified by nearly five hundred successful inoculations. Lesions may occur on any or all parts of a tree above ground, and may girdle anywhere. Most common places are crotches, base of trunk, and ultimate twigs. Roots and first-year wood are rarely, if ever, attacked. Sprouts are regularly formed below girdled points. Inoculations may take effect at any time of year, but the progress of the disease is most rapid in the spring months. A debilitated tree is no more subject to attack than a healthy one. Dry weather checks the disease by suppressing spore production. The parasite can enter without visible breaks in the bark, but wounds form the usual means of entrance. Of these the commonest are tunnels of bark borers. Winter injury is not common over the whole range of the bark disease, but may be locally important in producing lesions through which the parasite enters. Winter injury bears no other relation to the bark disease. The presence of *Diaporthe parasitica* Murrill forms a sure basis for distinguishing whether any given case is the bark disease or winter injury alone. The bark disease shows no definite relation to the points of the compass, the position of lesions being determined by the position of the wounds through which the fungus gained entrance. The present range of the bark disease is from Saratoga County, N. Y., and Suffolk County, Mass., on the north and east, to Bedford County, Va., on the south, and Greenbriar and Preston Counties, W. Va., and Westmoreland County, Pa., on the west.

Bacillus phytophthorus Appel: Dr. Erwin F. Smith, Department of Agriculture.

We owe the name and our first accurate information respecting this organism to Dr. Otto Appel, of Berlin. The following statements are the result of three years of study of this bacillus, cultures of which were received by me from Berlin

in 1906, and they are in the main only verifications or slight extensions of Dr. Appel's statements, which I have found to be very trustworthy. It is, however, I believe, the first description in English, and everything has been verified.

The organism is a non-sporiferous rod, variable in length, usually occurring singly or in pairs, but also forming chains of several individuals; taken from young agar cultures the diameter is about 0.6 to 0.8 μ, the length 1.5 to 2.5 μ; actively motile by means of peritrichiate flagella; stains readily with ordinary stains, but not by Gram's method; rots potatoes (stems and tubers), cucumbers, tomatoes, etc.; aerobe and facultative anaerobe; organism grayish white on agar and slightly bluish opalescent by transmitted light; surface colonies, on thinly sown + 15 agar, 1 mm. or less in diameter in 48 hours at 20° to 23° C., 2 to 3 mm. broad in 4 days; round, smooth, wet-shining, internally reticulated at first, amorphous under 16 mm. and 12 ocular, or with small flocks in the older portion; the buried colonies appear brownish under the microscope, also granular in the center; margin of buried colonies sharply defined; liquefaction of + 10 gelatin moderate to rapid; circular white colonies with regular margins on gelatin plates, visible in 18 hours at 30° C., in 26 hours at 21° to 23° C.; on thin-sown gelatin plates colonies grow rapidly and are frequently 2 centimeters in diameter at end of fourth day at 22° C.; alkaline reaction in gelatin cultures to which litmus has been added; on sterilized potato slow white to yellowish white growth; characteristic rapid white growth and black stain on raw potato (when streaked from agar); grows vigorously and with great rapidity on all neutral and feebly alkaline media; clouds 10 c.c. of + 15 bouillon in 6 hours at 30° C. and in 24 hours at 13° to 14° C., when inoculated with one 3-mm. loop from a bouillon culture 4 days old at 24° C.; especially good growth on neutralized potato-juice gelatin in which stab-cultures rapidly develop a funnel-shaped liquefaction, but less rapid in my hands than in + 10 peptonized beef-gelatin; gradual clouding of salted peptonized beef-bouillon, and production of chains therein and pellicle on undisturbed old cultures; no indol reaction; tolerates in beef-bouillon a considerable amount of sodium chloride (5 per cent.) and of sodium hydrate (+ 50); very active growth in potato-juice with formation of thick pellicle and heavy precipitate; rapid clouding of closed end of fermentation-tubes containing potato-juice, but no production of gas; no growth in Cohn's solution; slight greenish tinge in Fermi's solution on long standing; moderate production of hydrogen sulphide; distinct and persistent nitrite reaction in nitrate bouillon but no gas; grows in peptonized beef-bouillon from — 50 to + 16 and beyond, also in potato-broth acidulated to + 46 with citric acid, but no growth when acidulated to + 45 with oxalic acid; slow (acid) coagulation of milk with precipitation of the casein; slight reddening and final reduction of litmus in milk; slight production of gas in shake-cultures in some beef-agars; grows in bouillon over chloroform; in streak-cultures it reddens litmus agar decidedly in 48 hours at 20° C. in presence of either dextrose, saccharose, lactose, gelactose or maltose; it blues plain litmus agar decidedly in 48 hours and does not promptly redden the same with addition of dextrine or glycerine; no reddening of litmus in gelatin-cultures; the acid persists on boiling; produces small quantities of gas from innosit (muscle sugar), lactose and mannit; optimum temperature 28° to 30° C.; little growth below 4° to 5° C.; minimum temperature for growth in + 15 beef-bouillon 1° C. or under; maximum temperature for growth in + 15 beef-bouillon about 36° C.; thermal death-point in + 15 beef-bouillon 47° C.; ninety per cent. destroyed by freezing in bouillon. Appel reports loss of virulence in some of his cultures but I have not observed any during a period of three years. Undoubtedly a very large part of the potato rot of the United States is due to this organism. *Bacillus solanisaprus* Harrison is a very closely related, but not identical organism, causing a similar disease in potatoes. The same may be said of *Bacillus atrosepticus* Van Hall, cultures of which are not now available. The writer has isolated *Bacillus phytophthorus* from potatoes grown in Maine and in Virginia. The following are recommended as quick tests for differential purposes: very thin sowings on gelatin plates; streaks from agar to sterile raw potato; behavior in blue litmus milk; behavior in nitrate bouillon and in Cohn's solution. The right organism should produce big, round, white colonies promptly on thin sown gelatin plates, and should rot potato tubers promptly. It is not always easy to recover this organism from decaying potatoes, since it is quickly followed by various bacterial saprophytes —yellow and white species. The potato disease caused by this organism is known in Germany as "black leg," and by the writer as "basal stem rot."

The Central American Banana Blight: Dr. R. E. B. McKenney, Department of Agriculture (Laboratory of Plant Pathology).

In 1904 the writer made a trip through a number of farms in Costa Rica and in the Province of Bocas del Toro, Panama, for the purpose of investigating a serious banana disease reported by the planters during the two previous years. Since that time the disease has been more or less continuously studied by him.

"The disease" or "the blight," as it is commonly called by the planters, spreads rapidly. While in 1904 whole valley districts were free from the disease, there is now scarcely a single farm in the regions above mentioned that is not suffering from its ravages. The blight occurs in the Panama Canal Zone; also, by report, on the Atlantic side of Nicaragua, Honduras and Guatemala.

The disease has been known for many years, but only within the last decade has it alarmed the planters. As early as 1890 a few isolated spots were known to be affected, and from these the spread of the disease can be traced.

In Panama at least 15,000 to 20,000 acres of banana plantations have been abandoned and many thousand more are seriously affected, while in Costa Rica the damage has been even greater, so that it is safe to estimate at least $2,000,000 capital loss in these two regions in the last five years.

Young and old plantations are attacked with equal intensity. Plants are also attacked on various soils—sand, clay, etc. The disease seldom becomes evident until the shoots have reached a height of four to six feet at the collar (point where the leaves diverge). Commonly the first external sign is a rapid yellowing and subsequent browning and wilting of one or more leaves. Sometimes there is a striking curvature and yellowing of the terminal part of the leaf-blade while the remainder is still green. Eventually all the leaves die and fall back against the trunk, leaving a crop of suckers which in turn are killed and give place to still weaker shoots. The fruit of diseased shoots rarely matures and even when mature is worthless with blotched, somewhat shriveled surface and dry, pithy interior. Shoots which develop after one or two suckers have died rarely reach the flowering stage. When they do, however, weak, distorted, worthless bunches are produced.

On cutting the pseudo-stem across and longitudinally many of the bundles are found to be of of a yellow, reddish or reddish-purple color, the color deepening toward the rootstock. In the last stages the color of the bundles may be almost black. While in recently affected plants the vessels of the upper part of the stalk and the leaves may be normal, those of the rootstock are always colored. In most cases the thin partitions separating the air chambers are wrinkled and collapsed. The juice of diseased plants contains much less tannin than that of normal plants. A nauseating odor is often given off when leaf-stalks which have been diseased for some time are cut open, though there may be no sign of rotting in the trunk.

It has been proved that the disease is not due to local conditions such as too wet or too dry soil, etc., yet some of these conditions may predispose the plants to the disease.

There is a seasonal periodicity in the activity of the blight corresponding to the periodicity of growth in the banana plants. It is during the stage of most rapid growth that the plants most easily succumb, particularly from April to July. In periods of less active growth many plants seem to recover, but only to die during the next season of rapid growth.

Neither drainage nor improved methods of cultivation and pruning have checked the disease. Indeed, increased fertilization seems to make it more virulent. There is no evidence that insects are in any way responsible for the trouble.

Microscopic examination of the stained vascular bundles above mentioned shows that the coloring is due to a rather insoluble gummy substance (not a true gum) that more or less completely plugs the vessels and cells of the xylem. In this bacteria and, in some cases, fungus hyphæ, were found imbedded.

Bacterial organisms isolated in Central America from diseased material have been cultivated by the writer and inoculated into healthy plants on the plantations and in greenhouses of the Department of Agriculture in Washington. The results of this phase of the investigation will be given later. It may be stated, however, that the blight is in all probability a vegetable parasite which makes its entrance into the plant through the rhizome or roots.

No good method of control of the disease has yet been found. The progress of the disease in its early stages may be delayed by digging out and burning diseased plants, replacing them with healthy suckers.

The hope of continuing the banana industry successfully in the affected districts lies in the substitution of an immune variety. This the writer has found in a Chinese banana now occasionally grown in Central America. This sort is easily grown, yields good fruit, and has been found entirely resistant. The plantain is slightly but not seriously affected by the blight. The red banana is also subject to this blight, but less than the common yellow (Martinique) variety.

Notes on some Diseases of Trees in our National Forests: Dr. GEORGE GRANT HEDGCOCK, Bureau of Plant Industry. (Read by C. J. Humphrey.)

Notes were given on the occurrence and distribution on a large number of hosts of the following wound parasites attacking forest trees: *Polyporus dryophilus* Berk. (?), *P. obtusus* Berk., *P. sulphureus* Fr., *P. schweintzii* Fr., *Fomes igniarius* Gill., *F. applanatus* (Pers.) Gill., *F. laricis* (Jacq.) Murr., *Trametes pini* (Brot.) Fr., and *Echinodontium tinctorium* E. & E. Many new hosts for several of these species were named.

The more injurious species of mistletoe in our coniferous forests are *Razoumofskya douglasii* (Eng.) Kunze, on *Pseudotsuga taxifolia* (Poir.) Britt., *R. cryptopoda* (Eng.) Coville, on *Pinus ponderosa* Laws., *R. americana* (Nutt.) Kunze on *Pinus murrayana* "Oreg. Conn.," and *R. cyanocarpa* A. Nels. on *Pinus flexilis* James.

Of the species of *Peridermium* attacking trees in the same area, *Peridermium coloradense* (Diet.) Arth. & Kern on *Picea engelmanni* Eng., and *Peridermium elatinum* (A. & S.) Kunze on species of *Abies* are the more injurious.

Successful inoculations were made with the uredospores of *Cronartium quercuum* (Brond.) Arth. on oak leaves of a number of species for the first time, and with the teliospores of the same fungus, producing galls on the twigs of young trees of *Pinus virginiana* Mill.

Potato Wilt and Dry Rot (Fusarium oxysporium): Mr. W. A. ORTON, Bureau of Plant Industry.

This disease described by Smith and Swingle in Bulletin 55 of the Bureau of Plant Industry in 1905 is now coming into prominence as one of the most wide-spread and destructive maladies of this crop. It appears to occur throughout the United States, but is more injurious in the irrigated sections of the west and in the southern half of the potato belt.

Three types of injury occur. The most serious and least recognized is a wilting and premature ripening of the plant due to infection of the stem and underground portions. The second is a dry rot beginning at the stem, which develops most rapidly in warm temperatures. Finally, the disease is responsible for a portion of the trouble experienced from poor germination in the spring.

Of methods of control at present available rotation of crops appears most effective. Seed selection through discarding diseased portions of tubers has been proved helpful. A thin slice across the stem end affords a simple test, the vascular ring being brown where the fungus is present. There are indications that resistance can be bred, though no existing varieties are very promising in this regard.

The Double Blossom: Dr. MEL. T. COOK, Delaware Agricultural Experiment Station.

This is a disease of the genus *Rubus* originally attributed to *Fusarium rubi* Winter. It is very abundant on the Delaware-Maryland Peninsula, where it is destructive to the Lucretia and Rathbone dewberries. It is due to a fungus which appears to be a *Fusarium.* The fungus winters in the buds and the spores are formed in the open blossom. The effect of the disease is the formation of a witches broom, deformity of the blossoms and atrophy of the berries. Late blossoms are very abundant in the fields where the disease is present and also occur one year in advance of the witches brooms. These late blossoms also contain spores.

The Toxic Properties of Tannin: Dr. MEL. T. COOK, Delaware Agricultural Experiment Station.

Since the preliminary report given a year ago at the Baltimore meeting, work has been continued along the same lines and considerable additional information gained. None of the species of *Glœosporium* or *Colletotrichum* gave maximum growths on media containing more than two fifths of one per cent., and the majority gave best growths on media without tannin. *Fusarium* was much more resistant to low percentages, but none gave maximum growths above three fifths per cent. tannin.

Neocosmospora, Cladosporium, Sphæropsis, Sclerotinia and *Phoma* were more resistant than *Glœosporium,* but none gave maximum growths on media containing more than three fifths per cent. of tannin.

The species of *Penicillium* were retarded at first, but had a tendency to overcome the toxic action of the tannin.

The above experiments were duplicated with series of experiments in Van Tigheim cells, which gave more accurate results on germination of spores, maximum growths and formation of new spores.

A series of experiments was made to compare the growth of organisms in media in which the proteid and tannin formed a precipitate and in media in which proteid was not used.

A series of experiments was made to show relative resistance of cork from which the tannin had been extracted and cork soaked with tannin of various percentages.

Parasitism of Coryneum foliicolum and Phoma mali Schulz et Sacc.: Dr. CHARLES E. LEWIS, Maine Agricultural Experiment Station.

Coryneum foliicolum Fckl. has been reported as common on dead spots in living leaves of the apple, but in this investigation it has been found also in cankers on the branches. The fungus has been grown in pure culture on a number of culture media and inoculations have been made on leaves, wood and fruit of the apple. In confirmation of the work of others, it is reported that this fungus does not cause leaf-spot, but in this study it has been found capable of doing great damage to young apple trees and to small branches of older trees by causing cankers which may girdle the branch, killing the parts above the girdled region.

Phoma mali Schulz et Sacc. has been isolated from leaf-spot, canker, and decaying fruit of the apple. This fungus does not cause leaf-spot, but it can attack the wood of young apple trees and branches of old trees.

Both of these fungi have been tested as to their ability to cause decay of apples. *Coryneum* causes a small amount of decay in ripe fruit. *Phoma* causes a rapid and complete decay of ripe fruit and can attack green apples to a slight extent.

Lettuce Sclerotiniose: Dr. F. L. STEVENS and Mr. J. G. HALL, North Carolina College of Agriculture and Mechanic Arts.

A brief summary is presented of some of the experimental results of several years' study of lettuce sclerotiniose. The expansion of the lettuce industry and the history of this disease are mentioned. The results of a statistical study of spores from apothecia of different ages is presented, also of physiological studies concerning the temperature relations of the fungus, longevity of the mycelium under various conditions, effects of various nutrients and of alkalinity and acidity upon growth. The toxicity of various fungicides was studied, also the effects of illumination, depth of planting and stirring of the soil upon germination of sclerotia. The germination of ascospores in various media was studied, also their longevity. Special attention was given to the question of parasitism and saprophytism and to determining to what extent and under what conditions the mycelium could migrate through or over soil. The view is expressed that the ascospores and the mycelium are both short lived, that the sclerotium is the only long-lived structure and that the prevention of formation of sclerotia by the early destruction of effected plants constitutes a promising means of eradication of this disease.

Parasitism of Coniothyrium Fuckelii: Mr. P. J. O'Gara, Bureau of Plant Industry. (Read by title.)

A New Hop Mildew: Dr. J. J. DAVIS.

A downy mildew was observed on *Humulus lupulus* in Wisconsin in 1909 which is referred to *Pseudopteronospora celtidis* (Waite) Wilson as var. *Humuli* n. var. and a description given.

An Anthracnose of Red Clover caused by Glœosporium caulivorum Kirch.: Dr. H. R. FULTON, Pennsylvania State College.

The characteristic lesions are elongated, sunken areas on the stem, one centimeter or more long; these have dark brown borders, with lighter centers over which the acervuli are scattered. Inoculation tests indicate that infection takes place most readily through wounds, or upon succulent parts, or under very moist conditions. Under field conditions the most serious outbreaks probably occur when continued warm showery weather induces a very succulent type of growth. The conidia were found to retain their vitality in one instance for twelve months. Successful inoculations were made on *Trifolium pratense, T. pratense* var. *perenne* and *T. hybridium.* Unsuccessful attempts were made to inoculate *T. repens* and *Medicago sativa.* Rotation of crops, early mowing of affected fields, the use of uncontaminated seed and the planting of resistant strains of clover are suggested as control measures.

Further Studies of Phytophthora infestans: Professor L. R. JONES and Dr. B. F. LUTMAN, Vermont Agricultural Experiment Station.

The authors, assisted by Mr. C. R. Orton, have continued the work on *Phytophthora infestans* reported at the meeting last year. The principal advance has been made in the study of the resting bodies and in the improvement and testing out

of a laboratory method for determining disease resistance in the tubers.

In cultures of the fungus on lima bean agar and potato gelatin there were found, as reported last year, certain immature spore-like bodies. These have been found in similar cultures this year and also what appears to be a more mature stage, in the form of spiny, brown-walled resting spores apparently produced asexually. These have been found in all but three of the twelve strains now in cultivation, these three being either weak or recently isolated.

The method of testing the disease resistance of the tubers has been improved. Sterile living plugs cut from the tuber to be tested for resistance to *Phytophthora* are inoculated with the fungus and the amount of growth after nine to twelve days is compared with that on plugs cut from tubers known to be resistant or susceptible. In this manner over eighty varieties of potatoes have been tested and rated on a percentage basis as to their tuber resistance. The ratings were found to agree very closely with the relative tuber resistance, as shown by the field experiments conducted by Professor William Stuart. The probable advantage of the laboratory over the field method is obvious both in saving of time and in precision of results.

Some Studies on the Bean Anthracnose: Dr. C. W. EDGERTON, Louisiana State Experiment Station.

This includes the results of two years' study on the bean anthracnose under Louisiana conditions, including the period of incubation, methods of surviving the winter, relation of the fungus to temperature and various soil microorganisms, and the relation of the fungus to other anthracnoses.

Under the best conditions for growth of the fungus, the period of incubation is from four and a half to six days.

The fungus survives the winter by means of mycelium in the seed and by spores. On the diseased seed there are found some spores, at least as late as February, that are viable, and spores that are between the cotyledons in the seed, and so protected, are nearly all viable at this time. Spores are formed on the surface of the seed, between the cotyledons in the seed, or in closed pycnidial-like cavities in the tissue of the seed.

The fungus is not able to live in the summer months in Louisiana on account of the high temperature. In cultures in the laboratory with special care the fungus can be kept alive, though it makes a very feeble growth; but in the field the disease is killed out entirely. When a mean temperature of about 80° F. is reached with the minimum above 70°, growth seems to be prohibited.

Various organisms in the soil, especially a species of *Fusarium*, destroy much of the anthacnose in the seed. This is accomplished by rotting the seed, or by merely crowding out the anthracnose in the spot itself. A large per cent. of the spots on the cotyledons of young bean seedlings, that grow from spotted seed in Louisiana, contain *Fusarium* and no anthracnose.

Inoculations with spores of the bean anthracnose, have given abundant infection on bush beans, slight infection on pole beans, slight infection on Lima beans, and no infection on peas, young cucumber plants, cucumber fruits, alfalfa and cotton plants. Inoculations on growing bean plants or young pods with anthracnose spores obtained from fig, cotton, rose and pepper gave no infection, while check inoculations using spores obtained from the bean gave abundant infection. However, the treatment of healthy bean seed just before planting with suspensions of spores obtained from the cotton, fig and rose plants, resulted in many cases either in the rotting of the seed by the anthracnose or the spotting of the young cotyledons. These spots, however, though they contained anthracnose spores, did not look like bean anthracnose spots, nor did they develop further after the cotyledons were pushed above the ground.

Venturia inequalis, Ascospore Dissemination and Infection: Mr. ERRET WALLACE, Cornell University.

The life history of *Venturia inequalis* (Cooke) Wint. is in general well known to pathologists. The conidial stage grows parasitically on the leaves and fruit of the apple, causing the disease commonly known as "scab" or the "fungus." The perfect stage develops saprophytically on the fallen leaves during the winter, maturing its ascospores the following spring.

During the spring of 1908 and a portion of the winter of 1909, the writer gave some attention to a study of a few details of some phenomena connected with the perfect stage of this fungus.

In the spring of 1908 the method of ascospore discharge was quite carefully studied. Two types were observed, the one commonly known, by extrusion of the asci through the ostiole of the perithecium and another in which a circumcisal dehiscence takes place, the upper half or more of

the perithecium being burst off, exposing all the asci at one time.

The former is doubtless the natural method, but in many cases the number of asci preparing for action at one time may be greater than can be accommodated by the ostiole, and the expansive force bursts off the upper part of the perithecium.

By placing glue-coated slides at various heights over moistened leaves, some data were obtained as to the height to which ascospores may be discharged. This was not found to exceed 1.5 cm., and very few reached this height. In a similar manner it was determined that from a portion of leaf 1 cm. square 5,630 spores were discharged in 45 minutes. In an orchard set 40 feet each way, the surface of which was covered with fallen leaves, if no limiting factors were considered, there might be at this rate 8,107,200,000 ascospores to each tree discharged in a period of 45 minutes of wet weather.

During the winter of 1909, leaves examined at different dates showed that, by February 26, the perithecia had formed, in the asci of which was as yet no evidence of spore formation. Even at this stage, when pricked out in water on a slide, dehiscence of the perithecia would sometimes occur, without extrusion of the asci.

By March 20 immature hyaline spores had formed. On leaves kept in moist chambers in the laboratory since February 27, they were much more advanced, some spores being sufficiently mature to be discharged.

Infection of leaves was repeatedly induced by inoculation with ascospores. The method of infection was studied and camera lucida drawings showing the germ tube piercing the cuticle were obtained. The period of incubation varied from eight to fifteen days.

It seems probable that ascospore infection is, in most cases, largely responsible for early attacks of scab on leaves and petioles. The writer was called to diagnose a case in western New York, in which this fact was strongly evident. With one exception every orchard in the immediate vicinity had a very severe attack of early leaf infection. On talking with the owners, it was learned that the above exception was the only case in which the fallen leaves had been plowed under the fall before. An examination of those leaves remaining showed an abundance of perithecia.

Polystictus hirsutus as a Wound Parasite on Mountain Ash: Dr. Jas. B. Pollock, University of Michigan.

At Ann Arbor, Mich., two mountain ash trees were for several years under observation, each tree having one of its main branches partly dead, and in each case the dead branch was covered in part by sporophores of *Polystictus hirsutus* Fr. The diseased condition was progressive in both trees for several years, the trees gradually dying off, and both trees were removed before they were completely dead. Observations were made on one of them when it was dug up, and the decay of the wood had extended from the dead branch into the main trunk, to a point below the surface of the soil in which the tree stood. This decayed heart wood was filled with a white mycelium. Pieces of this wood were placed in moist chambers, and after a month or two fruiting bodies developed which showed it to be the same fungus whose fruiting bodies developed for several successive years on the dead branch fifteen feet above.

The observations seem to show that this fungus not only is a wound parasite, destroying the dead heart of a tree, but that it slowly and progressively attacks the cambium, gradually killing off this species of tree.

Notes on Plant Diseases in Cuba: Professor William Titus Horne, California Agricultural Experiment Station. (Read by C. L. Shear.)

A list of publications on plant pathology arising from the writer's work at the Cuban Experiment Station is given, and the following diseases of the principal cultivated plants are discussed: sugar-cane troubles—drouth, exhausted soil, moth borer and root fungus; tobacco—damping off, leaf spot and root disease; banana—an undetermined disease; mango and aguacate: mango—blossom and tip blight (*Glœsporium*), aguacate—destructive disease not determined. Also diseases of citrus fruits and vegetables.

Failures due to lack of adaptation or unappropriate periodicity are also mentioned and education and improved agricultural practise suggested as necessary to utilize the results of the plant pathological investigations which have been made.

Two Diseases of Cosmos: Mr. F. C. Stewart, New York Agricultural Experiment Station. (Read by title.)

A Cuban Banana Disease: Dr. Erwin F. Smith, Department of Agriculture.

My attention was first called to this disease in December, 1908, by Mr. Horne, of the Cuban Experiment Station, who requested me to study the cause of the disease. Up to this time I have been unable to visit western Cuba where it pre-

vails, especially in bananas used as shade for tobacco, but I have received several lots of diseased material, and now have affected plants growing in one of the Washington hothouses.

The signs of the disease so far as I have been able to obtain them from Cubans, and as the result of my own examinations, correspond quite closely to those described by Dr. McKenney, and also to the banana disease described by Mr. Earle from Jamaica in 1903. A similar, if not identical, disease prevails in Trinidad, according to statements made to me by Mr. James Birch Rorer, from whom I have also received alcoholic material. A similar disease occurs in Dutch Guiana, according to statements recently received by me from Dr. van Hall, director of the experiment station in Suriname. I am inclined to think that the Central American disease is also the same as this disease, although we are not yet certain, Dr. McKenney and myself having joined forces to settle, if possible, the problems relating to banana diseases in these regions. Possibly there are two banana diseases now confused—one due to bacteria, the other to fungi.

A microscopic examination of the Cuban material showed bacteria to be present in some of the vessels, but not in quantity sufficient to lead me to suppose them to be the cause of the disease. In passing, I might say that Earle sent me cultures of the bacteria isolated by him from the diseased Jamaican bananas and that in the summer of 1904 I inoculated these copiously into the leaf-blades and petioles of bananas in Washington, but without production of any disease. In the Cuban plants no fungi were observed at first, but further studies revealed a small amount of mycelium running in the vessel walls or their vicinity, but in no case plugging the lumen of the vessels. No spores were observed at first, but after awhile I thought I made out, although rather indistinctly, one or two microconidia, and jumped to the conclusion that the fungus was a *Fusarium.* Poured-plates were then made from the interior of affected leaf-stalks which were sound on the surface and a *Fusarium* was obtained on the plates in practically pure culture, the colonies having evidently been derived from microconidia present in the bundles. Transfers were made from these colonies and after a half-year or more, rapidly growing, large banana trees were inoculated from subcultures. The inoculations were made by means of punctures into the midrib, leaf-stalk and pseudo-trunk. At this time the bananas were about twenty feet high, perfectly healthy and with trunks a foot in diameter. As a result of these inoculations the writer obtained infection of the vascular bundles of the petiole of several leaves to a distance of from five to eight feet and more from the point of inoculation. The bundles became brown-purple in the typical manner and the *Fusarium* with microconidia was demonstrated in the interior of these bundles by microscopic examination, especially after treatment with 10 per cent. potash (drawing exhibited), and was also isolated from the same at this distance from the point of inoculation by means of Petri-dish poured-plates, the exterior of these petioles being at the time perfectly sound. It has thus been demonstrated beyond dispute that the affected Cuban plants contain a *Fusarium* which is able to run long distances inside of the vascular bundles and cause a purple, purple-brown or blackish stain of the same. What has not yet been demonstrated is that such inoculations will so disease the rootstock that other uninoculated leaves will subsequently show the typical signs of the disease. I was obliged to break off this experiment after about two months, owing to the necessity of moving the hothouse, and building another one before experiments could be continued. The rootstocks from which the inoculated infected leaves were cut away have, however, been planted out in the new house, and additional inoculations have been made, the results of which ought to be positive one way or the other in the course of the coming year.

The fungus may be designated for the present as *Fusarium Cubense.* It produces macroconidia and microconidia of typical form, reddens and purples various culture media, and has not so far shown any ascospore form. The chief characteristic separating it from other species so far as yet known is its location in the diseased banana plant and its ability to produce the beforementioned disorganization phenomena in the vascular bundles, but no doubt other peculiarities will be developed as the study of the organism progresses.

A very considerable part of the banana holdings in tropical America are in the hands of Americans, and as we also consume the greater part of the product, it is highly important to prevent such destruction of the plantations as shall lead to a loss of American capital and an increase in the price of this important food product.

The Blackleg Disease of the Potato in America: Professor W. J. MORSE, Maine Agricultural Experiment Station. (Read by title.)

Studies on the Club Root of Cabbage: Dr. Howard S. Reed, Virginia Agricultural Experiment Station. (Read by title.)

The Curly Top Disease of Sugar Beets: Mr. Harry B. Shaw, Bureau of Plant Industry. (Read by Mr. W. A. Orton.)

The various names by which the disease is known are briefly referred to, then follows a description of the symptoms observed to be characteristic of it. The fact that the resisting power of the beet varies according to the size of the latter is referred to.

The most important theories as to the cause of curly top are mentioned, together with a review of the writer's experiments covering many of the theories set forth.

Certain experiments with leaf hoppers commonly found on the beet, and the fact that the leaf hopper, *Eutettix tenella* Baker, is the primary cause of curly top in beets, is recited.

Observations were made to the effect that curly top disease may develop in beets planted for seed production the second season although no symptoms of the disease were visible when those beets were harvested the preceding fall. This was demonstrated to be the case, and experiments establishing this fact are described. This renders the disease a double menace to the production of beet seed.

Four Years' Results in Selection for a Disease-resistant Clover: Professor S. M. Bain and Mr. S. H. Essary, Tennessee College of Agriculture and Experiment Station.

The announcement was made by the authors in 1906 of the marked resistance shown by the progeny of select clover plants to the *Colletotrichum* disease occurring in Tennessee. This resistance has been maintained under various cultural and laboratory conditions for five successive generations, and there no longer exists any doubt as to the economic value of the strain being propagated. There will be about fifty acres grown in the seed crop during the season of 1910.

The indications are that a naturalized strain was found in the original selections. The resistance shown to the anthracnose is probably due to acclimatization, and is, therefore, not specific. An outbreak of rust in 1908 brought out indications of rust resistance also.

A Fungus Enemy of Mushroom Growing: Mrs. Flora W. Patterson, Bureau of Plant Industry.

The paper relates to the first occurrence of *Mycogone perniciosa* Magnus in American mushroom beds. The fungus was identified by the author in several collections received from mushroom beds in Pennsylvania during March, 1909. The disease caused by this fungus has long been recognized as a serious one by growers in England and on the continent. The parasite is variously referred to by writers as *Mycogone perniciosa* Magnus and *Hypomyces perniciosus* Magnus. The latter name was previously given it by Magnus in 1887, who, however, did not describe the perfect stage, but reasoning from analogy, inferred it would be found in the genus *Hypomyces*. Two conidial stages, a *Verticillium* sp. and *Mycogone perniciosa*, have been identified in the American material, and it is hoped that the perfect stage may develop in cultures that are being kept under observation.

European Currant Rust on White Pine in America: Dr. Perley Spaulding, Bureau of Plant Industry.

The European currant rust has two stages: one as *Peridium strobi* on the white pine, the other as *Cronartium ribicola* upon leaves of *Ribes*. The fungus is native in eastern Europe upon *Pinus cembra*, upon which it usually does little damage. Since about 1860 it has attacked *Pinus strobus, P. monticola* and *P. lambertiana*, all American species of five-leaved pines. At present it is distributed throughout Europe, and is causing great damage to white pines in certain sections. In the spring of 1909 it was imported into the United States upon about two and a half million young white pine trees, being distributed in the states of New York, Vermont, New Hampshire, Massachusetts, Connecticut and Pennsylvania. Lots of trees from the same nursery are also known to have been imported into Ontario and Minnesota. During the past summer a special effort was made to remove the *Ribes* from the vicinity of these plantations, and, it is believed, successfully, except in portions of Connecticut and in Ontario and Minnesota, which latter are to be inspected by local authorities. This work was carried on in cooperation with the forestry and plant pathological workers of the states involved. The National Department of Agriculture has absolutely no power to prohibit importing, or to inspect, condemn or destroy such imported stock, except by courtesy of the owner. The situation is especially serious should the importation continue in future years upon the same scale as during the last year. Immediate action should be taken by the various states in-

volved, either stopping such importation or providing such inspection and quarantine laws as are best adapted to the situation.

C. L. SHEAR,
Secretary-Treasurer

(To be continued)

SOCIETIES AND ACADEMIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 679th meeting was held on April 9, 1910, Vice-president Fischer in the chair. Two papers were read.

Times of Abruptly Beginning Magnetic Disturbances as Recorded at the Coast and Geodetic Magnetic Observatories: R. L. FARIS, of the Coast and Geodetic Survey.

The speaker gave a brief review of the researches that had heretofore been made by investigators concerning the sudden beginnings of magnetic storms, with special reference to their times of beginning at different places, the general impression hitherto being that they are simultaneous, or so nearly so, all over the earth that the time scales of the records were too small to warrant any other conclusion. Dr. L. A. Bauer having recently found that there is a definite time element in the propagation of the magnetic disturbance in some special cases investigated by him, the speaker, at his suggestion examined a number of cases of suddenly beginning magnetic disturbances recorded at the Coast and Geodetic Survey magnetic observatories, which cover a quarter of the globe in longitude, with the result that the investigation showed that there is a persistent time difference for the storm beginnings at different places which is too large to be attributed to errors in the time determinations, thus confirming the results of Dr. Bauer's recent investigations.

The paper will appear in full in the June, 1910, number of the *Journal of Terrestrial Magnetism and Atmospheric Electricity*.

On the Analysis and the Propagation of Magnetic Disturbances: Dr. L. A. BAUER, of the Carnegie Institution of Washington.

An examination of the times of beginning of the magnetic disturbance which occurred on May 8, 1902, as coincidently with the Mont Pelé eruption as can be determined, revealed the interesting fact that they were not the same all over the globe, being, in general, earliest at European stations. The times next progressed going around the earth eastwardly, the complete circuit being made by the disturbance in about three and one half minutes. This fact led to an examination of other similar disturbances, such as the one of January 26, 1903, and it was again seen that this one also progressed around the earth eastwardly, the time for the complete circuit being about four minutes.

Mathematical analyses were next made and it was found that for both disturbances (May 8, 1902, and January 26, 1903) the systems of disturbance forces which it would be necessary to superpose upon the earth's own magnetic field, were precisely of the same character as the earth's. In other words, were we to assume electric currents as forming the disturbance systems, then, as is the case for the earth's field, the currents would have to circulate around the earth from east to west if they are positive ones, and in the contrary direction—from west to east—if they are negative, or such as would be produced by moving negative charges. Furthermore, for both disturbances the electric currents would have to circulate chiefly in the regions above the earth.

For the disturbance of May 8, 1902, there were a sufficient number of reliable determinations of the effect on the vertical intensity and accordingly it was possible, by means of the analysis, to separate the external system of currents from the internal (below the surface) one. And then the surprising result revealed itself, that the internal currents went in the same direction as the external ones, the latter being of about three times the strength of the former. Hence, were we to suppose that the disturbance is caused by the motion of negative charges around the earth eastwardly, then the internal negative currents also go in the same direction and, accordingly, they are not currents induced in the earth by the outer system.

If the earth's own magnetic field is likewise separated into an internal system and an external one, it is also found that for both systems the negative currents go in the same direction around the earth, viz., from west to east. The disturbance systems found above are therefore precisely similar in character to the earth's field. It should also be noted that the direction of the disturbance negative currents progress around the earth in the same way as did the times of beginning referred to above. The assumption is therefore a natural one that such disturbances as here investigated, which Birkeland in his recent important work[1] called "equatorial perturbations,"

[1] Birkeland, Kr., "The Norwegian Aurora Po-